Where is IOE Heading?

By Jeffrey Liker, Newsletter Editor and Associate Professor, IOE

As we approach the new millennium we decided to devote an issue of the alumni newsletter to some reflection and forward thinking on the future of IOE as a professional discipline. The new millennium will bring more challenges than changing computer systems to recognize more than two calendar digits. The world facing today’s IOE graduates is dramatically different than the world I faced when I graduated as an industrial engineer in 1976. For one thing, virtually all of my fellow I.E. graduates were white males. The thought of a fellow industrial engineering student going to the Miss America pageant at that time was inconceivable (except perhaps in a day dream as I struggled to work on a linear programming problem). Today, our diversity in the classroom closely reflects the diversity in the U.S. When I graduated from college many of my fellow students expected to work for one large company for most of their careers. Today the half life of a job seems to be a few years and everyone wants to be an outside consultant. And the changes go on and on—the demand for a wide range of social skills in addition to technical skills, the necessity of working comfortably with computers, the need for involving people broadly in the process of change, and the rate of change itself. In this issue I asked some of my colleagues in IOE as well as some of our alumni active in the IOE alumni association to reflect on where IOE is headed. I hope you enjoy their musings.
Where are we heading? That question has been on the minds of the IOE faculty this year as we prepare for the next millennium. I am sure that many of you have probably been caught up in millennium projects as well (and some of you may even be making a business out of them!). This issue of your alumni newsletter provides some of our views.

The IOE department’s look at the future has included a strategic planning process for outlining goals for the department. We have been trying to identify trends and see how we can meet the great demand increase forecast by the Bureau of Labor Statistics growth projections (in particular, for operations researchers and systems analysts). As IEs, we have recognized that meeting that surge will require some combination of resource increases and efficiency gains.

On the resource side, we have long recognized the increasing need for information systems and technology training of our students and hope to have the College of Engineering’s approval of our hiring additional faculty in this area. We look for these new faculty to complement our existing strengths and to engage in research of long-term significance in the field.

With the advice and encouragement of our External Advisory Board, we are also exploring different models for the department that might include non-traditional faculty. Their work would focus on exploratory research and educational areas which might have high risk but also high reward potential. The life of these projects would be limited, but, from several of them, we hope to find one or two that produce new paradigms for IOE and then become part of the department’s core.

Our other efforts toward reaching more people with existing resources have included a growing presence in video courses and continuing education. Three IOE classes are now being offered to remote sites via the College of Engineering’s video network. We have also expanded our continuing education efforts, especially in ergonomics, from the traditional Engineering Summer Conferences to short courses at other locations, web-based classes, and a wider presence at the annual Management Briefing Seminars in Traverse City.

Our curriculum look at the future has consumed much of our energy over the past year. We are now committed to offering our undergraduate and beginning graduate classes on either a 2-credit, 7-week or 4-credit, full-term basis. We are re-crafting each course to fit this framework while we also try to ensure that we meet outcome objectives in the skill areas you have helped us identify.

With each of these efforts under way, the department aims to maintain and strengthen our position at the forefront of IE departments internationally. To help us shape our vision, I would like to hear your thoughts about where our field is going and how the department should respond. And, check views of our building on our web site (www.engin.umich.edu/dept/ioe/). Please visit often.

– John R. Birge, IOE Department Chair
The University of Michigan College of Engineering Alumni Society will award John E. Utley the Industrial and Operations Engineering Alumni Society Merit Award at the College’s annual Alumni Society Awards Dinner which will be held on October 31, 1997.

The Alumni Society Merit Awards were established to honor alumni who personify the College’s tradition of excellence and who have achieved significant accomplishments in their professional life. The Award is given to one alumnus from each of the eleven academic departments within the College. Recipients are selected by the departmental committees whose members are chosen and headed by the department chair.

John E. Utley is senior vice president of strategic marketing for Lucas Varity. He earned his bachelor’s degree in industrial engineering from the University of Michigan in 1964. He also earned an MBA from Wayne State University in 1972. Upon graduating from Michigan, Mr. Utley spent 18 years in various capacities with the Timken Company, rising to the position of assistant general manager of sales for the automotive division.

In 1982, Mr. Utley joined the Kelsey-Hayes Company as vice president, sales and marketing for the automotive group. He was appointed president of the automotive group in 1984 and was promoted to president and COO of the Kelsey-Hayes Company in 1988.

Kelsey-Hayes was subsequently acquired by Varity Corporation, which has since merged with Lucas Industries. Mr. Utley’s career continued to progress throughout this time, and he currently holds the position of senior vice president of strategic marketing for Lucas Varity, and vice president of sales and marketing of light vehicle braking systems. He has also served as chairman of the Hayes Wheels Company, the Dayton Walther Corporation, and the Kelsey-Hayes Company.

Mr. Utley has been active in several professional organizations, including the Society of Automotive Engineers (SAE). He served as chairman of the SAE International Congress and Exposition in 1990 and as chairman of the SAE National Passenger Car Meeting in 1984. He also served as president of the Automotive Original Equipment Manufacturers Association in 1987 and is a board member of the Motor and Equipment Manufacturers Association, the Detroit Area Council of the Boy Scouts of America, and the Citizens Research Council of Michigan. He was elected to the board of directors of Walbro Corporation in 1993 and has served on the Wayne State University School of Business Administration’s Board of Advisors and as a member of the University of Michigan College of Engineering’s National Advisory Committee.

Mr. Utley is past recipient of the Wayne State University Corporate Leadership Award and the Wayne State University School of Business Distinguished Alumnus Award.
Where is IOE Heading?

Operations Research
By Romesh Saigal, Professor, IOE

Operations Research is the science and art of optimally allocating scarce resources. The resulting decision problems are generic and a general methodology has developed around these problems. Such methodology has found many applications in both public and private sectors. These include decision problems in many diverse areas like manufacturing, telecommunications, transportation and service industries like banking/finance/insurance etc. OR tools are now routinely used to route calls along a telecommunications network, route city busses along a network of highways, schedule airlines and airline crew, manage and control inventory. This list is just a small subset of the many OR applications today.

Professionally, OR has matured into a well established and used discipline. As we move into the 21st century, and as our society becomes more integrated into the world as a whole, the complexity of interactions between individuals will increase beyond the comprehension of one individual or society unit. This will put greater demand on the available resources, both human and material. It is thus natural that a field that makes optimal resource allocations will find itself in great demand. The explosion of information and the emerging problems of human/machine interactions, may yet provide new application areas that we can only guess at today.

The need to solve even larger decision problems, coupled to an exponential growth in computing power has put new demands on bottleneck methodologies like combinatorial and non-linear optimization, dynamic and stochastic optimization and decision making under uncertainty. To cite an example of this, recently the Intel stock plummeted when it was noticed that the new Pentium 2 chip would require more wafer space than the earlier versions, and thus would require considerable investment in new plants and equipment. Such chips contain billions of transistors and placing them on a wafer can lead to an allocation problem requiring a solution of a massive optimization problem, way beyond the capabilities of today’s methodology. As we proceed towards the next century, such instances may become commonplace and survival may well depend on having such methodologies available. As resources become scarce, competitiveness demands their optimal allocation. Greater methodological developments in related areas will inevitably follow.

Challenges of the 21st Century: Care and Management of Human Resources
By Thomas J. Armstrong, Professor of Public Health and IOE

Nobel laureate Gary S. Becker states “human capital is the most important type of wealth in the U.S. and other modern nations.” (Business Week April 14, 1997). Although automation has become increasingly important, humans continue to be our most valuable industrial resource. Work and self sufficiency are considered to be important human values in our society. This is reflected in federal regulations that help to insure work opportunities for persons of all genders, ages, physical abilities and races. In addition, many programs have been enacted at federal and state levels to help persons on welfare find work and achieve self sufficiency.

The importance of manual work is particularly apparent in small businesses that find it cheaper to operate machines and perform assembly operations with manual labor than with hard automation. The benefits of manual labor are passed on to large companies, which increasingly rely on small companies to perform their manufacturing. Many large companies still rely on internal work forces that perform intense manual labor. Examples of these can be found in food processing, construction, auto assembly, insurance and parcel handling industries.
Unemployment rates have reached record lows and many people routinely work overtime or at a second job. In many cases these trends have been paralleled by increasing worker injuries and disability. Injuries result in personal suffering and lost earnings for affected workers and in lost work and compensation for employers. Frustration over how to prevent and manage these injuries may adversely affect worker-employer relations. *USA Today* (September 18, 1997) cites a case in which several workers received a multi million dollar judgment against Levi Strauss as a result of how their injuries were managed. Levi Strauss, generally held in high regard as a desirable employer, is now faced with increasing conflicts among workers and between workers and managers.

*Business Week* (December 23, 1996) describes the new Toyota Kyushu factory in which automation was cut by 75% of that used in its most automated plants. While decreasing automation, Toyota also sought to make the work more physically and psychological compatible for its work force. In so doing they were able to increase productivity by 10 percent while cutting defects by 80 percent. In addition, fatigue and stress related injuries were reported to be substantially reduced. Similar experiences have been reported by other domestic and foreign employers. These programs draw on traditional work measurement and motion economy concepts and often utilize joint worker-management teams for implementation.

US employers who fail to take reasonable precautions to prevent work-related injuries may be threatened with legal action from the US and state Departments of Labor. Such actions have resulted in multi million dollar penalties for some employers and the development of specific control programs. Presently the US Department of Labor is studying how to best regulate these problems in the future. A major difficulty for both regulators and concerned employers is knowing how to measure health problems and how to design work equipment and procedures to prevent work-related injuries.

Industrial and operations engineers can be expected to play prominent roles in solving these problems. Specific research goals must include development of improved analysis tools for assessing injury and for characterizing work-related stresses, studies of the relationship between work and health patterns that can be used to establish work design guidelines; development of models that can be used for designing optimal work processes and equipment, development of flexible organizational models that will help companies devise implementation plans best suited for their situation and assessing worker satisfaction. Achieving these goals is essential if we are to maintain our position as a world class economic, political and social power.
Where is IOE Heading?

The Future of Engineering and Technology Management
By Jeffery Liker, Associate Professor, IOE

Most engineers, whether they plan on it or not, eventually find themselves managing people. Many get an MBA as part of a plan to become a manager. Others are mainly interested in practicing their technical craft at first, and as time goes on discover they can make a greater impact by managing a group of technical professionals than by doing their own technical work. Engineering management in Universities got it’s start by offering professional Masters degrees in engineering schools. The idea was not to provide enough finance, marketing, accounting, etc. to make them general managers, but enough exposure to organizational behavior and project management so they could manage technical projects or technical departments.

As technology has become part of everything we do, largely due to the computer revolution, we now define technology and innovation management much more broadly. Technology and innovation management includes the management of technical personnel, the management of research, development, and engineering projects, the management of technical organizations, the management of technical resources, and the management of technological systems. Each of these broad topics has many sub-topics and draws on a variety of academic disciplines. For example, organizational behavior is key to the management of project teams, whereas much of what we know about the management of technical resources is based in economics. Questions range from how to design organizations to achieve cross-functional integration; to how to pick R&D projects worthy of resource investment; to how to design entire systems (factories, service operations) to integrate the social and technical systems.

The move in much of U.S. manufacturing from mass production to lean production is one example. As companies attempt to drive out waste and improve the flow of product through their operations they learn that it is a systems issue and a people issue, not just a narrow technical issue. People must be organized into teams of multifunctional workers who are involved in continuous improvement. The facility must be laid out and the supply chain must be managed to facilitate lean product flow. People must perform jobs in standardized ways for planning purposes and for purposes of continuous improvement. Who else has the background to understand these diverse areas besides the industrial engineer?

In principle, the industrial engineer has the breadth needed to take on any of these issues. They have enough technical background to understand what engineering specialists are trying to do and to manage interdisciplinary teams; they have enough understanding of work flow and organizational behavior to manage social and technical system design; and they have the finance/accounting background to make sound capital and R&D investment decisions. I say in principle, because in reality many of the lucrative contracts for major consulting projects in these areas today go to MBAs who may or may not have industrial engineering backgrounds. When a company is undertaking a major reengineering of their business processes industrial engineering is often not the first group that comes to mind in leading the change. I believe this is a matter of how we market ourselves rather than the reality of industrial engineer’s skills. Too many managers I talk to still think of I.E.s as the time and motion study guys.

This is not to say that industrial engineers are completely missing these trends. Many of our former students are working on fascinating projects that tax their technical and social skills in managing change. We are increasingly teaching teamwork and soft skills to round out the industrial engineering graduate. The Engineering Global Leadership (EGL) program initiated by Professor Jim Bean goes farther and requires I.O.E. students to develop international expertise, including language skills. So I.O.E. is positioned to be a leader in the new global era of rapid social and technical change. Are we up to the challenge?
Time Races On in Information Systems Development

By J. Dann Engels, President, The Waypointe Companies
http://www.waypointe.com

The world seemed neatly ordered when I left Michigan’s leafy campus in 1980, armed with an engineering degree and equipped with an education that would enable me (within my ordinary limits) to reason and (at least in some cases) to understand. It was, of course, a case of self-delusion, the arrogance of the supremely naive graduate.

What appeared obvious and immutable on the day I was granted my diploma now seems hopelessly outdated, even quaint. The world has changed dramatically and dynamically during the past 17 years, as the quantum shift from the Industrial Age to the Information Age has taken deep root and shaken more than a few paradigms.

I remain forever grateful for my education at Michigan, but today I see it more clearly for what it is — an exceptional foundation on which to build a career of consequence and important guidance for the initial steps along an unpredictable path of lifelong learning.

When I began my professional engineering career, I was (just as my professors and mentors at Michigan predicted) asked to think, to creatively design and implement solutions for some reasonably complex business problems. Yet, for all the advances in technology over the ensuing years (not to mention the additional generation of savvy U-M Engineering graduates in the marketplace), the complexity of business problems has increased exponentially.

Consider this example: You perhaps are familiar with the software brand names SAP, ORACLE, BAAN or Peoplesoft. They were not even glimmering notions during my student days, but today they dominate the global marketplace in large-scale computer software applications often referred to as “Enterprise Applications”. The company I founded a decade ago is closely acquainted with the Big Three in that industry (SAP, ORACLE and BAAN), serving as a partner to each of them in the installation and implementation of their software packages.

These software systems, unimagined not long ago, were created to fill a gaping need and are now indispensable to many businesses. And the huge systems that are designed for big-business customers often require years and many millions of dollars to install. It is an enormous undertaking, requiring an extraordinary investment of human and financial resources on all sides of the transaction.

Competitive pressures and capital considerations loom large in all of this, along with other tensions and ambiguities. It is a well-accepted rule of thumb that the less a client customizes its software, the less an installation will cost and the greater the likelihood the installation will run smoothly. With most software packages, financial modules are installed first. Accounting integration is the core of these systems and is supposed to be relatively simple to implement. Unfortunately, however, this assumption is not always accurate. When expected installations fall behind schedule and exceed budget, boards often give instructions that compromise functionality.

As those pressures mount, the once creative and thoughtful engineers of these systems move toward template masters and in the process compromise the optimal solutions for the expedient. This compromise is further compounded by the need to make sure that all company software is ready for the Year 2000, the much-ballyhooed Millennium Solution.

ERP implementations, for many customers, have been particularly strategic. Companies have achieved significant returns and solved Year 2000 problems simultaneously.

It is clear that between now and the Year 2000, packaged software will dominate the industry, and boards will expend copious amounts of money...
Where is IOE Heading?

because company auditors assure them that they have no choice but to do so. At the same time, engineers and software professionals will be asked to do their best to fit the software to the business. During this process, a great deal of good work is likely to be ignored and eventually forgotten. At Waypointe IT, we are committed to the proposition that a significant strategic advantage can be gained for companies with the resources and the time to go beyond financial integration to operations integration and on into their supply chain.

In upcoming issues of this publication, we’ll keep you informed on developments with SAP, ORACLE and BAAN, Peoplesoft especially in the context of its impact on engineers. We’ll also describe opportunities and techniques for Michigan IE’s to creatively engage in our craft and strategically support our organization. Further, we’ll explore both the wonders and the challenges of enterprise applications, as well as examining both operations software and supply-chain integration.

In every case, in a fast-changing world, a Michigan IOE education is well-suited for those who want to play a prominent role in thinking through, understanding, and resolving creatively the opportunities that we face, both for today and beyond the year 2000.

Where is IOE Headed in Manufacturing?

By Mike Zonnevylle, MSE IOE, 1989

As an employee of a large auto manufacturer and active member of the IOE Alumni Academy since its creation I have been asked to share my thoughts on the direction of IOE. In my opinion, the future of Industrial and Operations Engineering in large scale manufacturing is wide ranging and continually evolving. Traditional Industrial Engineering functions (time study, work measurement, budgeting, capacity planning, facilities layout, etc.) still serve a purpose in “Big 3” manufacturing. However, for some time this role has diminished in favor of other functions that capitalize on fundamental skills and capabilities of IOE graduates. Like any company, large manufacturers face constant competitive pressure for profitability. Success of the firm is measured by value returned to stakeholders as much as value delivered to customers. Industrial and Operations Engineers contribute to company profitability in several important ways, and can be summarized by process (manufacturing) engineering, production management, and specialized engineering skills.

Foremost, manufacturing companies like the Big 3 automakers look to Industrial and Operations Engineers as process experts. Skills developed through the degree program allow IOEs to effectively model and analyze complex manufacturing systems. Core skills (such as mfg. process technology, statistical techniques, engineering economy) provide the enabling tools to perform tasks from evaluating investment return to establishing machine capability and process control. Further, as large scale manufacturers turn to process automation and advanced computer technology to gain strategic advantage, IOE graduates are commonly involved in system analysis, development and implementation. Often it is an Industrial and Operations Engineer responsible for the redesign of processes that are efficiently automated or systematized. And in this environment, an IOE will be faced with finding an effective balance between automated and non-automated systems.

The processes that IOEs effect are not limited to production and are not local applications. Increasingly, large companies compete for profits in new markets around the world. With globalization comes new challenges such as developing creative ventures or business partnerships, solving obstacles inherent in international logistics and supply, and understanding and overcoming cultural differences. IOEs, with process and operations expertise, will be key to this growth.
Where is IOE Heading?

Not surprisingly **production management** is an area U-M Industrial and Operations Engineering influences greatly. In a recent survey performed by the IOE Department, over 35% of IOE Alumni described themselves as in production management or executive positions. To achieve continued improvements, large companies are turning to new work organizations such as self directed work teams and natural work groups to achieve even greater levels of productivity. IOEs are being asked to develop the environment and resources that maximize the effectiveness of these work groups. Most challenging will be the task of managing the transition from entrenched practices to new methods of management and production.

Sales and market share pressures drive a ceaseless focus on quality. Achieving ISO9000 or QS9000 quality standards through the institution of quality systems used to be a prized goal. It is rapidly becoming a business assumption. Quality Engineering is a **specialized engineering** area where IOEs (with strong foundation in statistics, probability and SQC) are playing an increasingly important role. Other emerging concerns are driving the need for engineers with special talents. For example, compliance to local and national regulations (OSHA, MIOSHA, EPA) as well as inexpensively finding improved ways of doing work are creating demands for IOEs with ergonomics and computer simulation skills.

The opportunities and potential for contribution by IOEs in large scale manufacturing are extraordinarily diverse. The background that the degree provides, particularly from a program as sound as U-M’s, makes the field nearly limitless.

Where are Services Headed?

*By Vance L. Shutes, BSE IOE, 1981*

Any discussion of where we area headed must begin with an explanation of where we have been. From the age of fifteen, my degree choice had already been made - Industrial Engineering. This was based on weekend introduction to IE with my dad. Once my entrance into U-M was assured, all efforts were focused toward getting the BSE IOE degree.

Given my earlier background in IE in a manufacturing setting, it was only natural that my first few jobs out of U-M were in the manufacturing arena, spanning from the Detroit area to the Los Angeles area. Upon my return to Ann Arbor, and my re-admittance to the MBA program at U-M, my career progressed into management.

Until one has served in a management position, it is difficult to understand the demands from within, from above, and from below. Having learned from a previous mentor that you should make decisions (in any position in the company) as though you are the owner of the business, it was only a matter of time until my style clashed with that of my direct manager. As this continued for an extended period of time, the entrepreneurial itch struck me right between the eyes.

Which leads me directly to an answer to “Where is IOE Headed?”. It strikes me that the development of entrepreneurial skills is critical to any IOE student, whether undergraduate or graduate degree. The graduate can then pursue virtually any career path - straight into their own business, or into a corporation to hone their business-management skills until the itch strikes (as it did during my corporate career).

My entrepreneurial itch took me into a sales position as a Realtor (presently associated with The Michigan Group in Ann Arbor). The problem-solving skills learned as an Industrial Engineer serve me well in the Real Estate industry, as do the interpersonal skills learned through the numerous team-based problem-
solving experiences in various IOE courses.

Each of us works in Sales - if only to sell our employers the need to retain our skills on the payroll.

Reforming Engineering Education: Curriculum 2000 and IOE
By Stephen M. Pollock, Professor, IOE

As many of you know, the College of Engineering has embarked on a complete redesign of the undergraduate curriculum. Following the recommendations (contained in the report “Michigan Curriculum 2000” — available from the Associate Dean for Undergraduate Education) of a faculty-student task force, all undergraduate engineering degree programs are being re-organized to provide students with a curriculum that has:

a) eight terms, each of which consists of four four-credit-hour courses (referred to as the “4x4x8” design).

b) a common first year, containing a new “introduction to engineering” course, as well as mathematics computer programming, physics, chemistry (or biology), and electives;

c) a number of identifiable “curricula threads” throughout the curriculum, including:
   • a demonstrated use of computers in each year;
   • the equivalent of three credit hours of communication skills
   • the equivalent of three credit hours of exposure to environmental aspects of engineering
   • professional ethics
   • the equivalent of four credit hours of dealing with uncertainty (e.g. probability and statistics)

d) at least 12 hours of free electives

The motivations for these changes are discussed at length in “Michigan Curriculum 2000”, as well as past issues of the Michigan Engineer. One expected outcome of the change is more students finishing the program within four years. The 4x4x8 design replaces the current irregular (and hard to conform to) eight terms, of four or five courses each, totaling from 15 to 17 hours. The first year curriculum will provide an early introduction to engineering concepts as well as communication, professional and ethical issues. The curricula threads and increased electives will serve to provide the broader education and opportunity for elective specialization needed by engineers in the next century.

The IOE department responded by first asking alumni, industry representatives and faculty about their perception of the necessary “skills set” our graduates should be able to demonstrate. We then challenged the faculty to re-assess, and if necessary re-design, our current course offerings courses and then produce a curriculum. One innovation was the creation of a number of 2-hour elective courses, designed to run over a half term (roughly 7 week) period. Using these, a student is enrolled in only four courses at any one time, but can be exposed to the material of two subjects instead of one. The result was an “IOE 2000” curriculum that satisfies the College’s guidelines, and yet retains the flexibility and emphases that have made our IOE undergraduate program so successful and attractive in the past. It is, of course, a “living document”, subject to change as our experience grows.

We will be enrolling the first cohort of students in this program as of Fall 1997, and intend to phase the program in year-by-year until it will replace the current curriculum as of Fall 2000 (an appropriate date)! The “template” that governs “IOE 2000” is essentially:
Where is IOE Heading?

Information regarding Curriculum 2000 can be found in the new College of Engineering Bulletin. For information on undergraduate, graduate or Ph.D. programs, please call (313) 764-3297 to receive a copy.

Subjects required by all programs

<table>
<thead>
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<th>Subject</th>
<th>Hours</th>
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<td>Math 115, 116, 215, 216</td>
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<tr>
<td>Engin 100, Engin 101</td>
<td>8</td>
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<tr>
<td>Chemistry 125/130 with lab</td>
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<td>Phys 140 w/ lab, 240 w/ lab</td>
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<tr>
<td>Humanities and Social Sciences</td>
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Subjects required by all programs (continued)

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<td>Chemistry 125/130 with lab</td>
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<td>Phys 140 w/ lab, 240 w/ lab</td>
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<td>Humanities and Social Sciences</td>
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Related Engineering Subjects

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<td>IOE 310, Intro to Optim Methods</td>
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<tr>
<td>IOE 265, Engin Prob and Stat</td>
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<td>IOE 333, Ergonomics</td>
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<td>IOE 415 (Stoch Proc.) or IOE 465 (Engin Statistics)</td>
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<tr>
<td>IOE 373, Data Processing</td>
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<tr>
<td>IOE Senior Design Course (IOE 424 or 481 or 499)</td>
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Required Program Subjects

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Technical Electives (note B)

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<td>Technical Electives (note B)</td>
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Free Electives

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<td>Free Electives</td>
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Note A) Select 12 hours; 4 hours from any three different groups:

- ME 211 or CEE 211 (mechanics) or ME 230 or ChE 230 (thermodynamics)
- MSE 220 or ME 281 (materials)
- EECS 210 or BioE 458 (circuits)
- AOSS 280 or CEE 380 or NERS 211 (environmental science)

Note B) Select at least 16 hours from IOE: at least 4 hours must be from 3 of the following 5 groups (the remaining 8 hours may be selected from any IOE course and/or from an approved list of non-IOE courses):

1 — IOE 441 (production and inventory), 447 (facility planning), 449 (material handling)
2 — IOE 415* or 465*, 460 (decision analysis), 466 (quality control)
3 — IOE 474 (simulation), 484 (database mgt.)
4 — IOE 432 (instrumentation), 433 (occ. ergo), 436 (hum factors in computers), 439 (advanced safety mgt.), 463 (work measurement)
5 — IOE 421 (work orgs.), 438 (occ. safety mgt.), 425 (mfg. strategies), 451 (engin econ.), 452 (cap budgeting), 453 (financial engin)

"only if not elected as a “Required Program Subject”

We welcome any comments on this re-designed curriculum, and hope that if you visit you will have a chance to see it in action.
Center For Ergonomics
By Don Chaffin, G. Lawton and Louise G. Johnson Professor, IOE

The Center for Ergonomics continues its research programs to understand how a variety of human factors affect the performance and safety of different operating systems. A partial list of these projects is:

• The effects on the operator of mechanical assistance devices (e.g., hoists and balance arms) when moving objects in different materials handling jobs.
• Human movements needed to reach and see objects while driving a vehicle.
• Arm and leg strength effects on performance of high exertion tasks.
• Ergonomics and safety considerations in trucking and warehousing.
• Job safety analysis in long-cycle-time manufacturing environments.
• Modeling and aiding highway traffic operators’ tasks.
• Computational modeling of human multitask performance.

Lanae Kimmerly (test subject) and Xudong Zhang (at desk) perform an automotive ergonomics study of driver performance while using control devices. The study focused on the number of devices a driver could use safely.

• Analysis of the pattern of muscle activity and force exertion when using computer input devices (keyboards, mouse, track ball, pen, touch pad)
• The effects of floor characteristics (compliance) on leg muscle fatigue
• Design of interface for remote driving of vehicles
• Driver performance of using control devices.

The above projects involve many excellent graduate and undergraduate students, some of whom came from departments other than IOE (e.g., Environmental and Industrial Health and Biomedical Engineering). Financial support for these studies is provided by grants and contracts from both industrial and government organizations who are concerned that the safety and health of workers is not adequately considered in the design of many manufacturing processes and consumer goods.

In addition to its research activities, the Center provides PC software for simulating human exertions, as well as a variety of 2-5 day professional development courses. Please call the Center at 313-936-0148 for flyers if interested in these outreach activities.

Tauber Manufacturing Institute - Get Involved

By James Bean,
Professor, IOE

The Tauber Manufacturing Institute (TMI) promotes cross-disciplinary education and research in manufacturing, combining the strengths of the College of Engineering, School of Business and many industry partners. In 1997, 24 teams of engineering and business students solved important manufacturing problems that required integration of
Program Updates

business and engineering knowledge and experience. These Team Projects involved 70 students and 39 faculty, many from Industrial and Operations Engineering. Students worked on site for four months.

TMI’s industry partners have realized millions of dollars of savings from Team Projects while substantially enhancing the education of many business and engineering students. Many companies have found Team Projects an invaluable recruiting tool, as many TMI students go to work permanently for the companies for which they did Team Projects.

In the Faculty Fellows Program, five teams of engineering and business faculty, aided by doctoral students, are conducting industrially relevant research with GE Lighting, GM and Ford, Libby-Owens Ford, NSK and Steelcase. Our hope is to integrate Faculty TMI students David Rochlen and Shance Hu during their Team Project at Boeing.

TMI students James Wu, Randy Guimes and Jeffrey Coffey during their Team Project at 3M.

Fellows and Team Projects so that research done by faculty can be implemented by student teams.

Each fall TMI and the National Coalition for Manufacturing Leadership sponsor the National Manufacturing Recruiting Forum. Approximately 200 students from over a dozen cross-disciplinary manufacturing programs at top schools join over 35 companies in two days of intensive interviewing in Ann Arbor. This fall we expect students from MIT, Northwestern, Stanford, Penn State, and many others to join a large number from U-M. The Forum takes place on November 20 and 21, 1997.

We invite your organization to get involved with TMI! You can sponsor a 1998 TMI Team Project. You can sponsor a team of Faculty Fellows. You can recruit students at the National Manufacturing Recruiting Forum. A great first step is to attend the annual Project Spotlight! Each Team Project from the previous summer presents their experience and impact. Industry executives judge the projects and award fellowships. Many companies have found this event an excellent way to get to know TMI. Last fall over 170 industry executives attended the Spotlight!

To get more information about any of these activities, contact Paul Kirsch at 313-998-8162, FAX 313-998-8164, email pskirsch@umich.edu.
Program Updates

Program in Manufacturing (PIM)
By Henia Kamil, Administrative Associate, PIM

The Program in Manufacturing (PIM), is an interdisciplinary program established in January 1993. The IOE department is extensively involved in the program and is represented by Professor Yavuz Bozer. Since 1993, PIM has graduated 41 students. PIM continues to attract graduated students to its Master of Engineering (M Eng.) program and Doctor of Engineering (D. Eng.) in Manufacturing program. Full-time work experience in manufacturing or a related field is a requirement for admission.

In January of 1997, PIM established its new Simultaneous Graduate/Undergraduate degree program, which allows students to acquire a BSE in IOE and M Eng in Manufacturing in 5 years.

In addition to courses they take in the College of Engineering, PIM students take classes from the Michigan Business School on topics related to finance, marketing, human resources and operations management.

For further information on PIM, please contact Henia Kamil at 313-764-3312 or hek@engin.umich.edu

Program in Occupational Safety Engineering and Ergonomics
By W. Monroe Keyserling, Professor, IOE

The IOE graduate program in Occupational Safety Engineering and Ergonomics has received a grant from the National Institute for Occupational Safety and Health (NIOSH) totaling $145,000 for the 1997-98 academic year. This grant is used to support the training of Masters and Ph.D. students who plan professional or research careers in Occupational Safety and Ergonomics. In addition, the grant supports library and laboratory facilities in the IOE Building. For additional information on financial aid opportunities, contact Prof. Monroe Keyserling.

As part of course revisions associated with Curriculum 2000, the existing safety management course (IOE 439) will be restructured into two 2-credit courses, each running approximately eight weeks. The first course will be a general survey of safety management issues, while the second course will focus on case studies. In another Curriculum 2000 change, the existing 3-credit work measurement course (IOE 463) will be reduced to a 2-credit, eight-week course.

In the Center for Ergonomics, subjects are put through a variety of tasks to determine work measurement. Here, Gerri Baker conducts a simulation for Ford sponsored research.
JTMP also funds research and our focus has been predominately on Japanese manufacturing. JTMP activities have led to the production of two books currently underway. One is a practitioner-oriented book that includes cases studies of plants in a variety of industries that have made progress in implementing lean manufacturing methods. Edited by Jeffrey Liker, it is called *Becoming Lean: Inside Stories of U.S. Manufacturers*, to be published by Productivity Press, and about half the chapters are written by IOE faculty, students and alumni. This will be out in November. The second book is an academic volume underway for 1998 publication: Liker, J.K., Fruin, M., and Adler, P. (editors), *Remade in America: Transplanting and transforming Japanese Production Systems*, Oxford University Press. We brought together academic leaders in this field from all over the country to Ann Arbor in September of 1996 to share papers, theoretical insights, and war stories and out of that conference came this book.

Finally, we are teaching courses in IOE. John Shook and Mike Rother teach IOE 425: Manufacturing Strategies which focuses on the Toyota Production System. Jeff Liker teaches an IOE graduate course on Japanese Technology Management.

In September the JTMP offices along with our Associate Director, Heidi Tietjen, moved from the Center for Japanese Studies to the newly renovated IOE building. In this way we will get even more closely integrated into IOE. One of the challenges to JTMP is to become financially self-sufficient. With the stream of support from our outreach courses and JTMP’s educational role in IOE we will undoubtedly be part of the landscape at Michigan for years to come.
Program Updates

Activities in Transportation
By Chelsea C. White, III, Professor, IOE

IOE students and faculty are involved with two of the on-going research activities at the University involved with transportation - The ITS (Intelligent Transportation Systems) Research Center and the Trucking Industry Program. Each of these activities continues to be a cooperative undertaking between several departments in the College and other units in the University, including UMTRI (the University’s Transportation Research Institute), the School of Business, the School of Urban and Regional Planning, and Literature, Sciences, and Arts. Both research activities are integrated with the Rackham ITS Education Certificate Program, a program that has graduated over 75 students in its seven year history.

ITS Research Center. The ITS Research Center is one of three such centers nationally. Major support for these centers comes from the Federal Highway Administration within the U.S. Department of Transportation. Our Center also receives support from the Michigan Department of Transportation and a variety of other public agencies and national and international firms. The mission of our Center is to perform research on technical, economic, and institutional issues associated with the role of information and its enabling technologies in transportation, with particular interest is its impact on safety, the environment, and economic competitiveness. Chip White serves as Center director. The Center sponsors approximately $1.8 million of research annually.

The Center’s research interests are broad scoped and include supporting such topics as: ‘Legal Issues in ITS’, ‘Willingness to Pay for ITS in the Pacific Market’, ‘Driver Eye Fixations Required by In-Vehicle Displays’, ‘Innovative Schemes in Congestion Pricing’, ‘Traffic Modeling and Dynamic Routing’, and ‘Spread Spectrum Extenders for Beacon-Based ATIS Networks’. Specific engineering-based research topic areas for which basic and applied doctoral research are supported include:

- The examination of how information made available from new information technologies can be used to improve transportation system, individual vehicle, and/or vehicle fleet measures of effectiveness.

- The identification and development of new information technologies that will provide data having potentially significant beneficial impact on transportation system, individual vehicle, and/or vehicle fleet measures of effectiveness.

- The examination of how these new forms of information, coupled with new control technologies, modify the driver-vehicle relationship in controlling the vehicle.

- The development of displays that effectively provide these new forms of information to the appropriate decisionmaker, e.g., the transportation system manager, the vehicle driver, the fleet dispatcher.

One of the activities of the ITS Research Center has been to serve as a founding member of the MOTORCITI consortium, a public-private partnership having as its objective the development of a commercial market for traffic congestion and incident information in Southeast Michigan. Members of the consortium are the Michigan Department of Transportation, the Road Commission for Oakland County, and the Research Center. Currently, due to the substantial investment in a transportation information infrastructure (comprised in large part of loops in the road and pole-mounted cameras) traffic congestion and incidents can be sensed in real-time in many areas in Southeast Michigan. This information...
Program Updates

is used now primarily for traffic management and emergency vehicle routing. However, such information has potential commercial value in providing information useful for routing to the private driver and the commercial fleet. The information provided from MOTORCITI will be made available to the ITS Research Center in real-time, will form the basis for future laboratory facilities for exposing students to state-of-the-art traffic and fleet management systems, and will serve a unifying focus of multidisciplinary research on the use of information in the transportation sector.

The University of Michigan Trucking Industry Program (UMTIP). UMTIP is a program supported by the Alfred P. Sloan Foundation which takes a multidisciplinary approach to the problems and opportunities confronting the trucking service industry. UMTIP involves faculty, research staff, and students from the Business School, the College of Engineering, UMTRI, the Department of Economics, and the Institute of Labor and Industrial Relations and faculty and students from the University of Massachusetts and the University of Wisconsin. The trucking service industry is by far the largest component of the commercial transportation sector, directly employing over 1.6 million people in the intercity transportation of goods and involving an additional 5.5 million people in goods-producing, goods-distributing, and goods-receiving industries. The trucking service industry currently accounts for 78.1% of freight revenue, 43.2% of freight tonnage, and 27.6% of ton miles. Current research thrusts include a driver survey, a less-than-truckload firm case study, an owner/operator survey, and a study of the role of information in the trucking industry. A joint activity between the ITS Research Center and UMTIP is a study of the newly emerging ITS industry, as a function of important, near-commercial products and services and to understand the market potential of adaptive cruise control, dynamic route guidance systems, and dispatch and navigation systems for commercial vehicles. Chip White serves as Co-Director of UMTIP. UMTIP sponsors approximately $750,000 of research annually.

Financial Engineering Update
By John R. Birge, IOE Department Chair

The Financial Engineering (FE) program is growing rapidly as students around campus and the world are hearing about the opportunities for highly skilled quantitative analysts and researchers. The FE program currently has 16 enrolled students with perhaps another two dozen who are participating in
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the FE seminar this term. Besides IOE, the students have backgrounds from multiple engineering departments (aerospace, electrical, materials, mechanical, nuclear), physics, mathematics, economics, and business. The first graduates of the program have found opportunities in federal agencies and the private sector.

FE students this term will be able to use the new Financial Engineering Laboratory in the Media Union. This system features the Reuters triarch trading system and will simulate actual trading with real-time data feeds from all major world markets. The system is enhanced by hardware supplied as part of a $6 million gift from Intel Corporation to the University. These computer systems will ensure that the latest state-of-the-art technology is available for students to conduct projects at the level of the practicing financial engineer.

NSF/ERC Update

By John R. Birge, IOE Department Chair

The National Science Foundation Engineering Research Center (ERC) on Reconfigurable Machining Systems begins its second year in 1997-98. IOE faculty have been heavily involved in the project from the beginning with Jim Bean leading the education effort, John Birge, Yavuz Bozer, Jan Shi, and Chip White all leading projects, and Steve Chick, Izak Duenyas, Tava Olsen, and Rachel Zhang as principal investigators. Each project also includes substantial industrial involvement to help widen ties between industry and the department.

The past summer of the ERC also included a set of case studies conducted by 3 IOE graduate and 6 IOE undergraduate students on the reliability of traditional fixed and newer flexible machining systems. The students visited multiple plants across the country, gathering data at each machine in a line over an extended period of time. Their reports provide crucial information about the advantages and disadvantages of each type of system and collectively form one of the most informative and realistic comparative system studies that has been done anywhere. We are all proud of our students for this effort and look forward to continued successes in the ERC in the future.

Near Zero Stamping Program—Overview

By Jianjun (Jan) Shi, Assistant Professor, IOE

The Agile and Precision Sheet Metal Stamping—Near Zero Stamping Program is a three-year project, jointly funded by the NIST-Advanced Technology Program and the Auto Body Consortium (ABC). The goal of the program is to develop a new generation of sheet metal stamping technologies to achieve precision and agility in sheet metal stamping:

(1) Precision: to improve the accuracy of stamped sheet metal parts from the present industry standards of a few millimeters to sub-millimeter tolerances.

(2) Agility: to reduce the time currently required for sheet metal die design, tryout, and production, by thirty percent (30%).

This program has been carried out jointly by twenty-two (22) Auto Body Consortium companies, in cooperation with the “Big Three” domestic automobile companies (Chrysler, Ford, and General Motors), and five research institutions (the University of Michigan, Ohio State University, Wayne State University, Sandia National Laboratory, and the Industrial Technology Institute).
The program focusses on critical issues in sheet metal stamping that have a large impact on precision and agility. The three major projects and 11 tasks in the program are:

**Project 1. Integrated Design for Stamping and Assembly**

- **Task 1.1** Optimized Design Process for Stamped Sheet Metal Components and Assemblies
- **Task 1.2** Computerized Formability Evaluation System for Sheet Metal Part Design
- **Task 1.3** Sensitivity Analysis of Critical Parameters for Reducing Stamping Variation
- **Task 1.4** Product/Process Optimization for Key Hemming Characteristics

**Project 2. Agile Stamping System Design and Try-out**

- **Task 2.1** Global Strain-Based System for Fast Die Evaluation
- **Task 2.2** Agile Die Tryout and Modification
- **Task 2.3** Integration of Material Handling and Press Motion in Die Design

**Project 3. Intelligent Stamping Process Monitoring and Control**

- **Task 3.1** Innovative Measurement Strategy
- **Task 3.2** Signature Analysis or Stamping Process Monitoring and Diagnosis
- **Task 3.3** Multi-Attribute Decision Supporting System for Die Predictive Maintenance
- **Task 3.4** In-Process Adjustment/Compensation System

The University of Michigan has played a leading role as a research institute. Dr. Jan Shi and other faculty members from several departments (IOE, MEAM, MSE, and Statistics) are involved in the project. Dr. Shi also serves as the Technical Director for the overall program, and represents the research institute on the Executive Committee Board of the NZS Program.

In the past year, significant progress has been made in the research. Various fundamental issues on die design and tryout, stamping signature analysis, die/press proactive maintenance, and innovative measurement strategies have been addressed. Industrial validations and implementations are being conducted in different stages. The program has generated significant interest from the stamping industry and has had a great impact. As an example, the Minster Company and other ABC members have donated stamping presses of more than one million dollars value to U-M to aid in the ongoing research. As pointed out by Ernie Vahala, President of the Auto Body Consortium and a long-term friend of U-M, “The NZS program provides the first-class researchers at U-M with the state-of-the-art industrial presses. The great impact will go beyond the NZS program’s duration.”

Dr. Mary Good, Undersecretary for Technology from the U.S. Department of Commerce, reviews NIST-ATP projects at U-M.
Student Organizations

Alpha Pi Mu (APM)
By Daniel C. Woolson, President

The University of Michigan chapter of Alpha Pi Mu, the National Industrial Engineering Honor Society, is planning an exciting year for its current members and new initiates. A primary goal set by the officers of Alpha Pi Mu this year is to increase the recognition of industrial engineering as a career choice within the College of Engineering. In addition, our society hopes to improve interaction between the students and faculty with the assistance of our faculty advisor, Professor Tava Olsen, and our Regional Vice-President for Alpha Pi Mu, Professor Gary Herrin. We strive towards these goals by planning various events that fall into one of four categories: Career Planning and Professional Development, Community Service, Fundraising, and Social Activities.

We assist students in recognizing the many applications of an IOE degree through our Career Planning and Professional Development activities. The “Career Options” night allows students to direct questions to a panel comprised of former IOE graduates who have gone on to receive MSE in IOE degrees, MBA degrees, and law degrees. A resume book is compiled of all Alpha Pi Mu students each year and is sent out to interested corporations. Moreover, we sponsor corporate presentations by such firms as Deloitte & Touche, Kurt Salmon, and Ernst and Young.

We are committed to serving our community. Our society will spend a day at a Habitat for Humanity site, as APM members will help to construct homes for low-income families. Other activities include working at a local soup kitchen and organizing a food drive near Thanksgiving. These philanthropic activities demonstrate that there is more to university life than just going to class.

Two other community service projects we will undertake are geared towards improving the recognition of industrial engineering as a career choice. Alpha Pi Mu will participate in Tech Day, a college wide event, which allows high school and freshman college students to learn more about various engineering disciplines. We will have the opportunity to talk to these prospective students on a face-to-face basis and tell them what it means to be an IOE student. Furthermore, we will take this message out to local high schools through a community outreach program.

Several fundraising activities are also on the table. At the end of this term, our society will sponsor a book exchange program. Additionally, we plan on selling IOE T-Shirts and organizing a raffle.

Social activities help to improve interaction between the students and faculty and Alpha Pi Mu and other engineering honor societies. Each term, Alpha Pi Mu sponsors the IOE BBQ, a great time for IOE students, faculty, and staff to get together. This coming October, Alpha Pi Mu is once again challenging Tau Beta Pi in a game of “Capture the Flag” in the Arb. Last spring Tau Beta Pi emerged victorious in this spirited game, but it will be a different story this year! Other activities on the calendar are Rock ‘n’ Bowl, Ice-Skating at Yost, and a Road Rally.

These are only a few of the events which we are sponsoring this year. We will organize many more events as the year passes. We are very interested in having IOE alumni return to campus and share their professional experiences. If you have any comments, suggestions, or would like to become involved in some of our activities, feel free to contact the APM officers at: apm.97-officers@umich.edu.

Institute of Industrial Engineers (IIE)
By Bree Bowersox, Chapter President

The University of Michigan Student Chapter of the Institute of Industrial Engineers (IIE) has many plans for the Fall 1997 semester. Our biggest function is the Career Pathways Dinner, which will be held jointly with the Detroit IIE Senior Chapter on November 4th. Other plans for the semester include rock-and-bowl, an Industrial Engineering speaker, a fundraiser, and possibly an Industrial Engineering community service project with a non-profit organization. IIE is also working on restructuring our student chapter. Goals for this semester include increasing membership and member involvement;
more mass meetings; and documentation for smoother officer transitions. IIE is also currently in the process of writing a constitution during the 1997-98 school year. We will continue to promote interaction of IOE students within the department as well as assist students in exploring their career options within Industrial Engineering. Please check out our web page for officer contacts and upcoming events: http://www.engin.umich.edu/soc/iie/

**Society of Women Engineers (SWE)**
*By Jean Marie DuBay, President*

We are well on our way into a very event filled and exciting semester. We will be having events that promote industry relations, public relations, outreach, regional events, and graduate relations.

The Society of Women Engineers is composed of over 300 members, both male and female. Our vision is to be the source of support and guidance for women in engineering at the University of Michigan and prospective women in engineering. Our mission is to provide opportunities for women engineering students to realize and achieve their full potential and demonstrate the value of leadership, teamwork, communication, and diversity. Some of our key objectives include:

* Developing the personal and professional skills of engineering students
* Enhancing student career opportunities and guidance
* Promoting professional and social networks for all engineers
* Encouraging high school women to enter engineering
* Providing informational resources for engineering students
* Maintaining communication through e-mail, meetings and the www site

I would like to take a few moments to tell you more about the actual activities we are involved in during this fall semester.

In the area of Industry Relations the fall is a very busy time for SWE. The SWE/Tau Beta Pi Career Fair will be held all day on October 13 this year. About 130 companies will be in attendance in order to recruit students of all engineering majors for permanent, coop, and summer work. Prior to the Career Fair, on October 12, Professional Development Day will be occurring. Many corporate representatives will be featured as guest speakers and to aid in resume critiquing and mock interviews. SWE hosts this event in conjunction with the National Society of Black Engineers.

We are also the proud hosts of the 1997 SWE Regional Convention. Students from schools throughout the midwest and corporate representatives will be at the convention. The convention will be held from November 7-9. The theme is “Team Leadership” and there will be many interactive, team building activities featured on Saturday. Friday night will feature an International Party with cuisine and dances from various countries. Saturday night a banquet is planned for all of the convention participants.

Throughout the semester SWE hosts Pre-Interviews Monday through Thursday night. Pre-interviews are

SWE President, Jean Marie DuBay, Kingsley Reeves and Jose Israel work on their TMI Team Project at UTA.
Student Organizations

informal information sessions featuring companies who are interviewing on campus.

This fall our SWE will be hosting a Shadow Day in which high school women will come to U-M and spend the day with another engineering student. There will also be a Girl Scout Weekend and high school visits to encourage young women to enter engineering.

Our graduate committee continues to host regular brown bag lunches/discussions, lab visits and activities to reach out to incoming graduate students and undergraduate students interested in graduate school.

In addition to all of these events we will continue to have our biweekly general meetings. These meetings often feature speakers and useful topics such as how to get an internship, resume writing, computer viruses, etc.

If you are interested in learning more about any of our events or would like to support us or help us out in any way please contact the SWE office: 1226 EECS Ann Arbor, MI 48109 (313)763-5027 swe.info@umich.edu

**Vibrant Industrial Black Engineering Students (VIBES)**

*By Kimberly Taylor, President*

The Vibrant Industrial Black Engineering Students organization was founded in 1993 for the purpose of enhancing the lives of past U-M black industrial engineering students. Since that time, the organization has expanded tremendously and has significantly enhanced the lives of many black industrial engineering students. Our vision is to increase the number of black industrial engineering students that excel academically, succeed professionally, and who positively impact the community. Our goals this year are to provide: sufficient academic support so that students may increase their academic performance, increase knowledge of numerous concentrations within Industrial and Operations Engineering, increase faculty and student relations, increase student awareness and knowledge about skills needed in order to be competitive within industry, and finally to increase the effectiveness of peer counseling for students. So as you can see we will be extremely busy this year trying to get these things accomplished. We plan on fulfilling these goals by inviting industrial representatives to speak at our meetings, plant tours, study jams, Crisp Help-Nites, and Faculty-Student mixers. Currently our meetings are held every 2nd Wednesday at 5:30 pm in 1680 IOE, and we welcome interested alumni to contact us at: kymt@engin.umich.edu or (313)662-2474.
Faculty Focus

Thomas Armstrong, tja@umich.edu

Thomas Armstrong studies health and performance issues in manual work. Along with Alfred Franzblau, Robert Werner, Randy Rabourn, Wendi Latko, Sheryl Ulin, James Foulke, a recently completed study at three industrial work sites showed that the prevalence of chronic muscle, tendon and nerve disorders of the hand and wrist increases with the repetitiveness of work. Wendi Latko’s dissertation, recently completed as part of this study, demonstrated that performance rating type can be consistently applied by different persons to assess risk of upper limb disorders. Armstrong also is collaborating with Drs. Martin and Franzblau on studies of upper limb disorders and the design of computer keyboards and office work stations. A recently completed dissertation by Michael Gerard showed that keying performance and fatigue are related to key stiffness and action. Future work will re-examine the contribution of vibration from hand tools to upper limb disorders.

James Bean, jbean@umich.edu

James Bean continues as Ford Motor Company Co-director of the Tauber Manufacturing Institute (TMI) and advisor to the Engineering Global Leadership Honors Program. He is also Associate Director for Education of the new Engineering Research Center in Reconfigurable Machining Systems. Professor Bean has been researching the mathematical foundations of genetic algorithms and stochastic models of large asset management problems. The latter is funded by two NSF grants and the Sloan Foundation. Professor Bean is co-teaching a cross-disciplinary course on Integrated Product Development with faculty from the Business School and School of Art and Design.

John R. Birge, jrbirge@umich.edu

John Birge has continued as Chair of IOE and also heads the new Financial Engineering Program and the System Design and Integration Thrust Area of the NSF Engineering Research Center on Reconfigurable Machining Systems. This project has involved original equipment manufactures in automotive, heavy machinery, and aerospace industries as well as machine tool builders and system integrators. Professor Birge’s other research supported by the NSF has focused on power systems and the construction of appropriate markets in the deregulated power market of the future. His textbook on the methodology of decision making under uncertainty, Introduction to Stochastic Programming, has just appeared and describes many potential applications as well as solution techniques.

Yavuz A. Bozer, yabozer@umich.edu

Prof. Bozer continues to work on the design and analysis of discrete-parts material handling systems as well as facility layout and factory design. With his student, he developed a new graph-based heuristic to solve a mixed-integer programming problem formulated for facility layout; this model has extensive applications in industry. He also developed a model to design and analyze automated storage/retrieval systems when storage and retrieval requests occur randomly, as in centralized work-in-process storage or “stockers” in semi-conductor fabs. Part of Prof. Bozer’s work is supported by the Center for Display Technology and Manufacturing (DTM) at the University of Michigan. The Center for DTM investigates process, design, technology, and manufacturing issues related to flat panel displays. Prof. Bozer is also working on developing reconfigurable material handling systems as part of his work related to the NSF-ERC Center for reconfigurable machining systems. In addition, Prof. Bozer serves as the IOE representative on the council for the Program in Manufacturing (PIM).
Don Chaffin, dchaffin@umich.edu
Don is continuing a laboratory study for Ford (with Jim Foulke and Chuck Woolley) to develop improved guidelines for the specification of mechanical hoists and articulated arms now commonly used to move materials in various plants and part distribution centers. In addition, Don is completing a three year study for Chrysler (with the assistance of Prof. Julian Faraway in Statistics), to model and predict realistic human reach motions used by operators of automobiles. Xudong Zhang's PhD thesis relied on this later project, and several papers have been published describing both investigations. A consortium of companies are expected to fund additional studies in a new Center for Human Motion Simulation and Modeling to be directed by Don this next year.

Stephen Chick, sechick@umich.edu
Stephen Chick has expanded his research and applications work in simulation. He is currently working on several projects with graduate students, including the development of reliability simulation and quality control software for an auto maker, with Professor Henderson; the simulation of disease transmission processes to improve health care quality, with Prof. Jim Koopman from the School of Public Health; and the optimization of reconfigurable machining systems using simulation analysis, with several colleagues under the umbrella of the UM ERC for Reconfigurable Machining Systems. Prof. Chick’s research is focused on the application of formal decision-theoretic procedures to statistical problems faced in discrete-event simulation. He continues to teach courses in information systems and simulation, and will be offering a new version of the department’s graduate level course in simulation this winter.

Paul Green, pagreen@umich.edu
Paul Green was just promoted to Senior Research Scientist in the Human Factors Division at UMTRI. In addition to teaching, Paul continues to work on research projects to make future vehicles safer and easier to use, projects that involve the use of a driving simulator and instrumented test vehicles. Several studies (for Mitsubishi Motors and United Technologies) have concerned how drivers use menus (resembling those on personal computers) while driving to interact with vehicle systems too complicated to have dedicated controls and displays. To design route guidance systems that minimize distraction, he has conducted several studies on the time to read electronic maps (for Toyota) as a function of the number of streets shown, how they are labeled, etc.. Other studies have concerned driver understanding of warnings in future cars (for Volvo) and predicting the time required to enter destinations into a navigation computer (Siemens). As a consequence of these studies, Paul is now writing an international safety standard on what navigation functions drivers should be allowed to access while driving.

Walton Hancock, whancock@umich.edu
Professor Emeritus Walton Hancock retired in January 1997. Since then, he has increased his consulting activities with various organizations. He is assisting Philips Semiconductors, where he has developed and is helping to implement a plant product scheduling system and staffing system. His activities at the Delphi divisions of General Motors and with Gelman Sciences include the introduction and implementation of Lean Production Systems. He has helped reorganize the information systems of the Indian Health Service. He is attempting to introduce High Performance Production Teams in the General Electric Lighting Plant. He has helped reduce the operating costs of a Levi Strauss Plant. His TMI students were instrumental in improving the productivity of the Chrysler Jeep Plant.
Faculty Focus

Shane Henderson, shane.henderson@umich.edu

Shane Henderson continues his work in simulation, and is currently focusing on efficiency improvement techniques for the simulation of multi-class queueing networks. These networks are often used to model semiconductor manufacturing facilities, and are extremely difficult to analyze. Beginning this Summer he will be working with Steve Chick on a project with Chrysler Corporation to improve decision making through the use of statistical simulation models. Through the Tauber Manufacturing Institute, he will also be working with Intel on their simulation models. He continues to teach courses in operations management, and is offering a graduate course in simulation in the Winter semester (1998). Update -- Due to difficulties with the Immigration and Naturalization Service, Shane Henderson must return to his home country of New Zealand for 2 years. He is currently applying to the university for a 2 year leave of absence, and hopes to be able to return to IOE in 1999.

Gary Herrin, gdherrin@umich.edu

Gary Herrin continues to serve as Undergraduate Program Advisor for the department. This past academic year, the department graduated the largest class in IOE history with 140 BSE degrees conferred. He is currently in the second year of a research project sponsored by PPG Industries, Inc. attempting to quantify the benefits of a proactive ergonomics process in terms of productivity, quality, and health/safety. A second project is examining Body-In-White manufacturing process capabilities for Chrysler Corporation. A third study is looking for methods to improve productivity and efficiency of highway maintenance operations. This past year he chaired 3 dissertations on such diverse topics as Optimal Design of Experiments, Modelling of Warrantee Claims, and SPC with Batch Chemical Processes. He currently advises 6 PhD students with topics in Multivariate Statistical Process Control, Quality Improvements in Service Industries, Statistical Tolerancing, and Ergonomics of Quality.

W. Monroe Keyserling, wmkeyser@umich.edu

Monroe Keyserling continues to serve as Director of The University of Michigan Center for Occupational Health and Safety Engineering. He will be ending a four-year term as IOE Graduate Program Advisor in December. Keyserling is presently involved in a three-year study to develop innovative approaches for controlling ergonomic stresses in Mopar parts depots. This project is jointly sponsored by Chrysler and the United Auto Workers. He recently completed a two-year project sponsored by PFS Food Services to reduce injuries in trucking and warehousing operations. Results of this work were presented in July at the International Ergonomics Association meeting in Tampere, Finland. During the summer, he also served as faculty advisor to a TMI student team that developed a Job Safety Analysis program for Boeing. Keyserling will be spending the winter term on sabbatical in Freiburg, Germany. He will use the sabbatical to interact with several European ergonomic research centers.

Jeffrey Liker, Jeff.Liker@umich.edu

Faculty Focus

Yili Liu, yililiu@umich.edu

Yili Liu continues his research in driver performance modeling and decision support for control room operators. In addition to publishing in academic journals, he has written a book chapter for the Handbook of Human Factors and Ergonomics, which was published in 1997 by Wiley. He has also co-authored an introductory human factors textbook, which is now in the galley proof stage. The publisher of the textbook is Addison-Wesley-Longman. He continues to teach an introductory ergonomics course at the undergraduate level and a cognitive ergonomics course at the graduate level.

Katta Murty, murty@umich.edu

Katta Murty submitted a proposal for the GAANN (Graduate Assistance in Areas of National Need) fellowships program, which was awarded for 5 fellowships in the department for 3 years (Sept. 1997 to August 2000). He is going back to the Hong Kong University of Science and Technology during summer 1997 to continue collaboration with faculty there on optimizing the operations in container shipping terminals.

Tava Olsen, tlennon@umich.edu

Tava Olsen received a three year reappointment in Spring of 1997. She continues her research on the scheduling and analysis of manufacturing systems. She is an active participant in both the Engineering Research Center for Reconfigurable Manufacturing Systems and the Tauber Manufacturing Institute. Professor Olsen continues to teaches courses in simulation and stochastic processes. Last winter semester she introduced a new graduate course in stochastic processes designed to fill current gaps in the stochastic processes curriculum.

Stephen Pollock, pollock@umich.edu

Stephen Pollock is continuing to work on a variety of research projects, with students and faculty colleagues from throughout the university, including: classification of spot welds; modeling urinary tract infection occurrence; modeling the spread of HIV; explaining the observed distribution of numbers and sizes of gametes; structuring body-panel die buy-out decision making, and a continuing analysis of general “detection of change” algorithms and policies. He co-supervised TMI student projects, over the past two years, at AP Parts International Inc., Intel and AlliedSignal. He continues to serve on the Army Science Board and (with Vijay Nair) on a National Research Council panel evaluating Statistical Methods for Testing and Evaluating Defense Systems. Steve was awarded the college of Engineering’s 1996 Service Excellence Award for his 27 years of contributions to the department, college and university.
Romesh Saigal, rsaigal@umich.edu
Romesh Saigal’s book, “Linear Programming - a Modern Integrated Analysis” published by Kluwer Academic Publishers in late 1995, is going into second printing. In the words of a reviewer “After so many books on linear programming published over the past four decades, finally comes a linear programming book that is for the first time not dominated by the classic simplex methods, but by a new class of methods: interior point methods.” Y. Zhang, SIAM Reviews, 38 (1996) 711-712. Professor Saigal supports his research on various aspects of Optimization by grants from NSF and DOE. His most recent research involves the use of semidefinite programming to generate bounds for hard combinatorial problems, and with his student C. J. Lin, has solved the largest such problem which generates a lower bound for the quadratic assignment problem, a well known hard combinatorial problem.

Jinajun (Jan) Shi, shihang@umich.edu
Jan Shi serves as the Associate Director of the S. M. Wu Manufacturing Research Center (WuMRC), and is also the director of the newly established Laboratory for In-Process Quality Improvement Research (IPQI). He is also the technical director of the NIST/ATP-funded Agile and Precision Sheet Metal Stamping—Near Zero Stamping Program. Prof. Shi and his colleagues in the Department of Mechanical Engineering and Applied Mechanics (MEAM Department) have jointly developed a new graduate course called “Automotive Body Manufacturing Processes.” Three of his Ph.D. students defended in the last year, and currently seven Ph.D. students and two post-doctoral fellows are working on his research team. Prof. Shi’s research focuses on the development of IPQI methodologies and their implementation in stamping, assembly, and machining. His research is being funded by the NSF-CAREER Program, NIST-ATP, the Auto Body Consortium (ABC), Chrysler, GM, and other industries.

Robert Smith, rlsmith@umich.edu
Robert L. Smith recently received his fourth NSF grant in Infinite Horizon Optimization research and continues his work in dynamic route guidance under a contract from the Intelligent Transportation Research Center at the University of Michigan. He is also working under subcontract to MITRETEK to develop a very large scale simulator for the Seattle traffic network. One of his PhD students (Dan Reaume) recently graduated to take a position in the Operations Research Department at General Motors Research Laboratories under another of his PhD students (Jeff Alden) who will act as his section head. A third student of his (David Kim) recently left the OR Department to take a professorship at the University of Massachusetts at Amherst.

Chelsea C. White III, ccwiii@umich.edu
Chip White’s current professional involvement includes serving as Director of the Intelligent Transportation Systems (ITS) Research Center, Co-Director of the Sloan Trucking Industry Program, Editor-in-Chief of the ITS Journal, and Editor of a series of books on ITS. His current applied research interests involve examining the role of information in transportation and more specifically the value of real-time traffic information on commercial fleet management in urban areas. He continues to study the integration of various models of sequential decisionmaking under uncertainty, e.g., Markov decision processes and AI-based heuristic search, with application to vehicle routing. Research sponsors include FHWA, Siemens Automotive, Ann Arbor Transportation Authority, the Road Commission for Oakland County, NSF, and the Sloan Foundation.
Rachel Zhang, rzhang@umich.edu

Rachel Zhang continues her research in the area of production and inventory control under the NSF Career Grant. She is currently working with four Ph.D students in studies of inventory systems with several demand types, production planning when future demand is uncertain, optimal modular design for reconfigurable manufacturing systems funded by the Engineering Research Center, and the optimal control of a production system with multiple servers. She has also developed new research interests in production planning in the presence of financial constraints. Professor Zhang continues to teach courses in production and inventory control at both undergraduate and graduate levels.

Special Honors

Outstanding Teaching
Karl D. Majeske

Graduate Student Instructor of the Year
Terri Lynch-Caris

Wyeth Allan Award
Adil Haque

Outstanding Undergraduate Student
R. Mark Krankel

Outstanding Graduate Student
Wendi A. Latko

Andersen Consulting Scholarship
Jean Marie DuBay

Andersen Consulting Michael Goldberg Scholarship/Internship
Matthew J. Blosl

Vulcan Award
Lydia Eutsey

Distinguished Leadership Awards
Adil Haque
Bryan Griffith
Shannon Wahl

Barth Prize
Jan Opdyke

Hellworth Award
Bryan Griffith

Irv Otis Scholarship
Carolyn Nguyen

Marian Sarah Parker Award
Jean Marie DuBay

Congratulations!!
IOE Student Named Miss Michigan, 1997
Modified Article By Janet Adamy
Michigan Daily Staff Reporter
Re-print Courtesy The Michigan Daily

How many of you had a Miss America contestant in your graduating class? Or, a Mr. Ann Arbor for that matter.

The winner of this June’s Miss Michigan Pageant, IOE student, Kimberly Stec, arrived in Atlantic City on Labor Day to compete against 50 other women for the coveted Miss America crown.

The road to the Miss America Pageant began when Stec started dancing at age five. She participated in her first pageant at age 17, saying it promoted academics by awarding contestants scholarships. It also gave her an opportunity to showcase her dancing skills, Stec said.

“Someone mentioned to me that the Miss America Pageant program really promotes talent ... so (as a dancer) it was kind of a natural step,” Stec said.

Stec claimed her first crown in 1995 at the Miss Heart of Michigan Pageant in Kalkaska, in northern Michigan. Winning the Miss Washtenaw County Pageant in the fall of 1996 qualified her for the Miss Michigan Pageant - which she went on to win this past June.

So far, Stec has received $13,000 in scholarship money that she has put toward earning her degree in industrial and operations engineering - $3,000 of which she just received for being a Miss America Pageant contestant. Stec is taking the year off to serve as Miss Michigan, but plans to return for her senior year next fall.

A Rochester native, Stec is a member of the jazz company at Ann Arbor’s Jazz Dance Theater and is a member of the University’s Society of Women Engineers. Last year, she served as the rush chair of the Delta Gamma sorority.
Charitable Contributions

We would like to thank the following supporters during our building renovation and expansion. Your financial pledges have made the project a reality. However, we are still in need of your financial support to continue the endeavor. And, as always we have other needs such as student fellowships and scholarship support and equipment to allow students and faculty to make the most from their research.

Remember that you may take full-market value deductability for appreciated assets, and that many corporations offer matching funds. The back cover has been provided for your convenience in mailing a donation. We appreciate your continued support!
Alumni Updates

This news is from alumni responses to the last newsletter. We’d love to hear from you! Please use the back cover to drop us a line and tell us what you are doing. Remember to include any name or address changes.

Richard Duffy (BSE ’92) now works at Detroit Diesel as an Associate Manufacturing Engineer.

Eric Hann (BSE ’92) now works at Production Modeling Corporation as Applications Engineer. He is currently developing a corporate workstation downtime database for General Motors to support their discrete-event simulation efforts.

Andy Heckroth (BSE ’87) is now pursuing an MBA degree at the Pacific Lutheran University. He now works at the Boeing Commercial Airplane Group as Supervisor of Composites Fabrication and Assembly where he manages the transfer of production work to external Boeing suppliers.

Robert E. Johnston, CAPT, USN (BSE ’74, MSIOE-Purdue ’80, M.A. in National Security and Strategic Studies-Naval War College) has returned to U-M and is now the Commanding Officer and Professor of Naval Science for Michigan’s Naval ROTC Program.

Deok-Soo Kim, Ph.D. is now an Assistant Professor in IOE at the Hanyang University in Seoul, Korea.

John J. Ling (BSE ’82, MBA-SMU ’89) now works as VP Logistics & Distribution for Crate and Barrel, Inc. He is responsible for supply chain management, worldwide sourcing through domestic retail supply and encompasses retail for housewares, furniture and catalogue sales.

Richelle Post (BSE ’96) now works as an Operations Research Analyst at ZS Associates.

Jonathan Simon (BSE ’78, MBA-Harvard ’80) is President and CEO of Quality Air Products. He is also an accomplished concert jazz pianist with seven recordings on the Silver Lining record label (self-produced but distributed throughout the world).

Chris Stiehl (MSE ’74, MA Psychology ’73) is now the Senior Project Manager-Market Research at Pacific Gas & Electric. There, he creates and manages public opinion measurement systems.

Donald D. Sullivan, ESQ. (BSE ’92, J.D.- U of D ’96) is now in private practice at the Law Offices of Stephen Peterson in New Mexico.

Daryl C. Weinert (BSE ’86, BA Economics ’86) is now Vice President of First Chicago NBD Bank where he is responsible for commercial accounts.

We regret to inform you that Norman L. Crawford passed away on December 17, 1996.
RESPONSE FORM

For Alumni History, Future Newsletter Items, and Offers to Assist the Department

The Department and your fellow alumni would like to know where you are, what you are doing and any other news you’d like to share. We invite you to return this form so that we may include this information in future newsletters.

We also welcome any contributions of time or funds. Use this convenient form for such purposes. Also, recently, you should have received a solicitation form from the College of Engineering requesting a year end tax contribution. For the IOE Department to be credited with your contribution, you must designate “IOE Department” on any pledge or contribution sent to the College or University. (Note: Michigan residents receive a particularly large deduction on the first $500 donated)

Please return this form to: John R. Birge, Chair
Industrial and Operations Engineering
University of Michigan
1205 Beal Avenue
Ann Arbor, MI 48109-2117

Name_______________________________________________________________________________________________
Address _____________________________________________________________________________________________
IOE Graduation Year/Degree Received __________________________________________________________________
Other Degrees Received ______________________________________________________________________________
Place Of Employment __________________________________________________________________________________
Job Title _____________________________________________________________________________________________
Responsibilities _______________________________________________________________________________________
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Check below if you would like information on the following:

[ ] Speaking about your profession at an IIE/APM/VIBES luncheon
[ ] Sponsoring a senior project team
[ ] Joining the alumni academy
[ ] How your company can sponsor research
[ ] How you or your company can financially assist the department

Enclosed is $ ____________ for the general support of the educational programs in Industrial and Operations Engineering.
(please make checks payable to "The University of Michigan")

Department of Industrial and Operations Engineering
The University of Michigan
1205 Beal Avenue
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